Roborace Requirements

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CHANGELOG

Version	Date	Comment
1.0	2021-02-01	Initial draft by {mnamcheva}
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Goals

G.1 Overall context and goals

Roborace is a global championship between autonomous cars, that allows testing driverless technology in the extreme conditions of competition. The participating teams get access to a racecar called Robocar and simulation facilities and have to develop the software to drive a Robocar in racing conditions. The teams are not allowed to modify the hardware.

The Roborace provides facilities for driverless technology development and testing. The SIT team aims to use this opportunity to develop software that can be licenced and sold.

The current project focuses on developing the software for Robocar.

G.2 Current situation

The hardware is developed and maintained by Roborace. The vehicle is fully ready for autonomous racing and technical specification is provided to the SIT team.

[To clarify in the next sprint:

- What particular information about a racetrack is provided by Roborace
- What software is provided by the Roborace team]

G.3 Expected benefits

Promotion of SIT as the pioneer of driverless racing.

Revenue from the sales of the developed software.

G.4 System overview

G.5 Limitations and exclusions

Table 1. SWOT analysis

Strengths	**Opportunities**
Team’s experience in driverless vehicles software research	Develop driverless vehicle software without a need to develop and maintain hardware
	Promote SIT as Roborace attracts public attention
Weaknesses	**Threats**
	Dependance on Roborace as they define the race goals and provide testing facilities

	Traveling restrictions due to Coronavirus outbreak, resulting in remote collaboration within the team

Risks:

- Missing data regarding vehicle's pose
- Losing vehicle's control
- Collision with another vehicle
- Collision with an obstacle
- Driving off the track (all 4 wheels outside of the track)
- Driving off the track partially (3 or less wheels outside of the track)

Risk consequences:

- Not finishing the race
- Light damage of the ego vehicle
- Severe damage of the ego vehicle
- Severe damage of another robocar

G.6 Stakeholders

Here is a non-exhaustive list of the stakeholders.

Table 2. Target side stakeholders

Stakeholder	Category	Comment
AV operators	User	
	Subject-Matter Expert	
SIT Legal department	Legal	Intellectual property issues should be addressed
	Subject-Matter Expert	
Project Manager	Decision maker	
SIT Roborace project team	Testers, Documenters, Developers	
	Trainers	For now there are no trainers, but potentially training will be required for the new system's users

Stakeholder	Category	Comment
Roborace management		As the people who “set the rules of the game”: racing goals and conditions; access to the testing facilities; information disclosure rules
Roborace system engineers		As the people responsible for the hardware

G.7 Requirements sources

- Articles in the field of autonomous driving, and in particular those that refer to the Roborace championship
- News articles, press releases related to the Roborace
- Books on autonomous driving
- Regulatory documents on autonomous driving (for example, ISO/PAS 21448:2019 Road vehicles — Safety of the intended functionality)
- Hardware specification documents
- Project stakeholders

Environment

E.1 Glossary

{Electronic control unit (ECU)}

An embedded unit in the vehicle that controls one or more electrical systems, such as the engine control unit or the human-machine interface.

{Race control unit}

Roborace representatives who are responsible for monitoring and supervising the practice sessions, the qualifying sessions and the race itself.

{Curb}

Flat curbstones lining the corners or chicanes of racing tracks. They are often painted red and white, and are intended to prevent unauthorized short-cuts and keep the racers safely on the track.

{Obstacle}

{Inside line, outside line}

White lines on the sides of a race track, defining a drivable area

{Drivable area}

Safe for driving area of a race track, bounded by Inside line and Outside line.

{Pit}

an area of a racetrack where pit stops are conducted.

{Racetrack}

A circular road with a hard surface built for racing of the vehicles

{DNF}

Did Not Finish. A run is scored as a DNF when a portion of the course was not completed or when a car fails on course.

{Ego vehicle}

The vehicle, the behaviour of which is of primary interest.

{System}

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E.2 Components

- Racetrack
  - Surface
  - Inside line, outside line

    - starting line
    - traffic signs (if any)
    - curbs
    - landmarks
- Vehicles
- Obstacles
- Surroundings, spectators
- Weather conditions
    - Wind
    - Light conditions
    - Precipitation
- Race control unit
    - Telemetry system
    - Race engineers

E.3 Constraints

[BR] A car starts a race positioned at the starting line of the racetrack.

[BR] If there is no wheel slipping, a car is moving towards its heading direction

E.4 Assumptions

The robocar and Devbot 2.0 have the same dynamics

All roborace participants are able to communicate in English

The measured vehicle’s speed equals to actual vehicle’s speed with an accuracy TBD

> (Author: M.Naumcheva
> Date: Sprint 1, Jan27
> Resolve by: Sprint 2, Feb 5
> Importance: serious
> Resources: ask customer)

The estimated vehicle’s pose equals to actual vehicle’s pose with an accuracy TBD

> (Author: M.Naumcheva
> Date: Sprint 1, Jan27
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> Importance: serious

Resources: ask customer)

The racetrack surface is clean and in good conditions

The racetrack surface is not slippery

E.5 Effects

- As the Roborace is initially created as a self-driving cars competition, the software implementation should not have any effects on the environment
- Currently the software is checked by the Roborace team before each competition. When the system is fully implemented, this process might change.
- The implementation of fully autonomous racing vehicles will lead to a redesign of the racing championship, as the racers' personalities play an important role in it. These changes are out of scope of the RMPS project.

E.6 Invariants

In a normal mode the vehicles move within the racetrack limits

Project

P.1 Roles

P.2 Imposed technical choices

P.3 Personnel characteristics and constraints

P.4 Schedule, milestones, and deliverables

P.5 Description of individual steps and tasks

P.6 Risk and mitigation analysis

P.7 Requirements process and report

System

S.1 List of components

The software includes the following modules:

1. Perception module
2. Mapping and localization
3. Planning
4. Control

S.2 Provided functionality

The system shall generate 2D and 3D map of a racetrack

The system shall provide the position and orientation of the AV

The system shall calculate the racing line (path and velocity) for a given track

The system shall find the fastest overtaking maneuver for the car (local path and velocity)

The system shall generate the control commands

The system shall detect and localize obstacles and another vehicles

The system shall provide object tracking and path prediction

The system shall perform road segmentation: detect drivable space, road defects

S.3 Provided interfaces

- Data input from the sensors
    - Exchanged data
- Race control unit
- Safety module

S.4 Example scenarios

General scenarios

- Avoid_obstacle_or_stop
- Move_to_the_pitlane
- From_start_to_finish_line
- …

Components-specific scenarios

1. Perception module
    - scenario 1
2. Mapping and localization
3. Planning
4. Control

S.5 Prioritization

At this stage no prioritization is defined.

S.6 Verification and acceptance criteria

At this stage no prioritization is defined.